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Configural Information Processing  
in Audit Evidence Evaluation

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University of Illinois at Urbana-Champaign

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Configural Information Processing in  
Audit Evidence Evaluation

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Abstract

In contrast with prior auditing studies (and more general psychology findings), we argue in this paper that many experienced auditors are able to process information configurally. This conflict with prior research is attributed to two characteristics of such research: (1) insufficient attention to domain-specific knowledge and (2) problems associated with the methods used to detect, measure and assess configural information processing. To support these arguments an experiment was conducted in which practicing auditors performed an auditing task for which configural information processing would be consistent with sound domain-specific knowledge. In addition, the experimental data were analyzed and hypotheses evaluated using methods refined to overcome the indicated empirical problems. The resulting evidence consistently supported our thesis, and related research and practice implications are discussed.



A vexing conclusion of many judgment and decision making studies is that human information processing may be characterized primarily by independent rather than patterned (or configural) cue usage. With one exception (Schepanski [1983]), accounting and auditing information processing studies also have reported little or no evidence of configurality (see Ashton [1982, 1983] and Libby [1981] for reviews). This conclusion is vexing not only because judges often describe their processing schemes in terms which strongly suggest configurality but because common sense tells us that it would have been difficult for societies to have evolved to their present states if their members only were capable of independent information processing.

The primary thesis of this paper is that, in contrast with prior auditing research, configural information processing is a skill that many experienced auditors have developed. Further, we propose that the inability of the scholarly literature to demonstrate the use of such skills by auditors is due to two characteristics of the prior research. First, following Frederick and Libby [1986], we argue that, although effectively absent from the prior auditing research, domain-specific knowledge is crucial for developing expectations for, and thus, demonstrating, configural information processing. That is, the researcher must use an understanding of the audit domain both to determine which judgment tasks might be more effectively (efficiently) accomplished using configural processing and what configural processing would

mean for such audit tasks. Subsequently, the researcher must construct experimental tasks sufficiently "realistic" to stimulate an auditor-subject performing the task to process information in a configural fashion. Implicit in this argument is the assumption that if sound domain-specific logic involves configural information processing, judges who are expert in that domain will have learned to use such configurality.

Second, following Schepanski [1983], we argue that prior auditing studies not only used a research method (analysis of variance [ANOVA]) which is a limited detector of configurality but also focussed on an insufficient configurality criterion (i.e., explained variance). While explained variance can be informative, it is only suggestive of the errors which may be made if an expert's actual judgments were to be predicted by a model comprised only of terms determined to be significant using the explained variance criterion. Further, explained variance provides no information with respect to subsequent costs of judgment errors which, in many audit contexts are asymmetric. Thus, consistent with Schepanski [1983], it is our belief that a predictive ability criterion (i.e., an appraisal of potential judgment errors) must be used in concert with the explained variance criterion.

To provide evidence relevant to our thesis, domain-specific knowledge is employed both to identify a fundamental audit task in which configurality should be important and to develop hypotheses consistent with our expectation that configural

information processing will be evident. The audit task chosen is assessment, given evidence produced by specified audit procedures, of the risk of financial-statement error. Subsequently, the results of an experiment are reported in which a case was administered to practicing auditors who were asked to make the required risk judgments. Such judgments were analyzed using both the explained variance and the predictive ability criteria and, in concert, evidence of configural processing is reported. As discussed below, these results have significant implications for evaluating how and how well auditors process information, as well as for the development of computer-based models of auditor's judgment and decision making (e.g., expert systems).

The next section of this paper reviews prior configural processing research in psychology and auditing and thereby, further develops the importance of domain-specific knowledge and the predictive ability criterion for this type of research. The third section develops a conceptual framework for the experimental task culminating with presentation of the hypotheses to be tested. The fourth section describes the laboratory experiment and presents experimental results, while the final section contains discussion of related research and practice implications.

### Prior Research

Research on configural processing has appeared in both the psychology and accounting literatures. The primary purpose of this section is to briefly review the findings of these studies, drawing out concepts and results germane to our foci: (1) domain

specific knowledge and (2) criteria necessary for determining both the existence and importance of configural information processing.

#### Domain-Specific Knowledge

The series of papers on auditors' evaluation of internal controls is the most prominent example of auditing studies which investigated configural processing. Following their psychology research predecessors, auditing researchers worked within the policy-capturing paradigm and employed factorial designs within ANOVA versions of Brunswik's Lens Model to study configurality.<sup>1</sup> In addition, these auditing studies, again following the precedent established in the psychology studies, searched for evidence of configural cue usage by examining the statistical significance of the explained variance attributable to interaction terms within ANOVA models.

The first such study was reported by Ashton [1974]. While many extensions have been reported, all offered essentially the same conclusion.<sup>2</sup> That is, based on both an examination of the number of interaction terms which provided a statistically significant increment to overall explained judgment variance and the magnitude of the explained variance attributable to such terms, auditors do not process information configurally. More specifically, the results reported in Ashton [1974] are typical: focussing on all possible two-way interactions, less than 9% were statistically significant and only 1% explained more than 5% of total judgment variance. Although across auditor-models the mean

explained judgment variance attributable to all possible interactions was 6.4%, the highest mean explained judgment variance attributable to any single interaction was less than 4%.

Not only are the foregoing results typical of the auditing studies, but they also are typical of the results reported in prior psychological studies. With a few exceptions<sup>3</sup>, Hoffman's [1968, p.60] conclusions remain an accurate characterization of the psychological research on configurality today:

" ... large amounts of empirical data support the hypothesis of linear [non configural] cue-utilization. Little or no residual variance remains following the determination of the composite linear effects of the variables, other than that which should be accounted for by unreliability or error. Furthermore, these findings have been found to hold for a variety of judgmental domains, utilizing different sets of objective information; and the findings appear valid for experienced decision-makers as well as for naive subjects."

Hoffman's [1968] further discussion of configurality, however, reflects considerable disenchantment with this conclusion due largely to its inconsistency with subjects' frequent reports and his intuition that configural cue usage is important. Most importantly, he [1968, p. 63] also observed that for a variety of reasons (i.e., statistical as well as others), " ... an undirected search for configural relationships within a finite set of data is fraught with difficulties and virtually doomed to disappointment." We not only agree with this statement, but elaborate as follows: as the complexity of the decision context increases (i.e., the number of dimensions or terms increase) the problem of parameter estimation also increases to the point that interactions, without a priori expectations, become very difficult to

detect. Thus, we believe that a major reason for the failure of prior auditing studies to detect configural information processing, is that no such study provided a priori expectations for specific cue interactions. Indeed, some studies simply expanded the number of information cues under the assumption that the chances of detecting configural processing would be increased.

An examination of the prior auditing studies also reveals that while such studies focussed on the same audit task (i.e., internal control evaluation), no study advanced reasons why one should expect configural processing for that task (see Frederick and Libby [1986]). Further, our examination of the instruments employed in the prior auditing studies, from the perspective of the domain-specific knowledge required to complete the experimental tasks, suggests that configural information processing was not required (see Brown and Solomon [1989]). Consequently, one cannot rule out the possibility that configural processing was not evident in prior audit studies because it was not consistent with the sound domain-specific logic that expert auditors would employ while completing the experimental task. It remains an open question, therefore, as to whether evidence of configural information processing would be obtained if one were to identify an audit task in which configurality is consistent with sound audit logic, develop specific expectations about the manifestations of such configural processing, design appropriate cases, and have experienced auditors formulate judgments in response to such cases.



## Existence and Importance of Configural Processing

As a number of prior researchers have noted,<sup>4</sup> factorial ANOVA research designs can be problematic. While several troubling characteristics often are mentioned (e.g., design representativeness which can result in implausible cue combinations and unrealistic frequencies of occurrence), we focus on problems inherent in detecting and interpreting configural effects.

Two characteristics of ANOVA are germane to this discussion. First, as observed by Hoffman, Slovic and Rorer [1968] and Ashton [1974], most judgment contexts, including auditing, are characterized by ordinal, rather than disordinal, relations between information and judgments utilizing such information.<sup>5</sup> ANOVA, however, has a limited ability to detect configural information processing when such processing is expected to be manifest as an ordinal interaction. As shown via simulation by Yntema and Torgerson [1961], for example, even when information processing is known to be configural, ANOVA will attribute virtually all of the explained variance to main effects rather than to ordinal interactions. Further, as shown in Brown and Solomon [1989], the theoretical limit to the magnitude of an ordinal interaction's explained variance (without changing its form to disordinal) is the explained variance attributable to the constituent variable that mediates the relationship between the primary constituent variable and the judgments.<sup>6</sup> Therefore, when defining configural information processing as the presence of ordinal interactions, one should not expect the explained variance attributed by ANOVA

models to such interaction terms to be large either in an absolute sense or relative to main effects.

Second, when statistically significant, but small (as judged by proportion of explained variance) interaction terms are present, an appraisal of the substantive importance of such interactions requires examination of prediction errors and associated costs. In particular, it is problematic to interpret the explained variance attributable to a term as an indicator of the prediction error that would occur if the term were to be dropped from an ANOVA model of the individual's judgments.<sup>7</sup> This problem arises, in our context, because explained variance measures are scale-free, whereas measures of prediction error (and cost) are scale dependent. Thus, when the individual's overall judgment variance is large, even judgment model terms with "small" proportions of explained variance can have relatively large judgment prediction errors if such terms are dropped. Alternatively, when the individual's overall judgment variance is small, even terms with "larger" proportions of explained variance can have relatively small judgment prediction errors. Further, the costs associated with prediction errors are especially important when different prediction error types result in asymmetric costs (e.g., the audit effectiveness costs attendant with audit risk understatement may be considerably larger than the audit efficiency costs attendant with the audit risk overstatement).

Summarizing our arguments, the import of significant, although small ordinal interactions within ANOVA models cannot be

adequately appraised solely via contribution to explained variance. Further, two characteristics of the prior auditing studies which investigated configural processing, insufficient attention to domain-specific knowledge and over-reliance on the explained variance criterion, have inadvertently lead to the vexing conventional wisdom that auditors do not process information in a configural fashion.<sup>8</sup> Subsequent sections of this paper illustrate how domain-specific knowledge and more complete evaluation criteria can be used to facilitate the design, conduct and analysis of experimental investigations of configural information processing in auditing.

#### Domain-Specific Knowledge Required For Evaluation of Audit Procedures

Consider a situation in which an auditor is concerned with the risk that a particular account balance, accounts receivable within the present study, is presented in conformance with generally accepted accounting principles. As reflected in the audit risk model (AICPA [1983]), both indirect evidence (i.e., evidence relevant to inherent and control risk assessments) and direct evidence obtained from substantive procedures (i.e., tests of details and analytical procedures) should be collected and evaluated to appraise the risk of erroneous financial-statement presentation. Prior research (and, to some extent, practice) suggests that the circumstances of specific audit engagements, rather than "general rules of thumb" should dictate which audit procedures

are appropriate as well as when and to what extent they should be performed (cf., Mock and Wright [1982]).

Such a contingency approach to audit program planning, in the context of accounts receivable verification, may be illustrated as follows (Wright and Mock [1985]). The auditor first identifies specific assertions which are to be the focus of attention. If, for example, the auditor's primary concern were the existence of recorded accounts receivable, a prominent procedure would be direct confirmation of recorded balances with creditors. While a number of options exist in this regard, if first (and subsequent) confirmation requests were sent in a positive format and sufficient confirmations were returned, a conclusion about the existence of the accounts receivable may be formulated. On the other hand, if a sufficient number of confirmations were not returned to the auditor, evidence would have to be obtained by performing another procedure (or set of procedures).

Confirmation, therefore, may be viewed as a primary procedure while procedures such as verification of sales transactions and observation of subsequent collections may be viewed as alternative (or "fall-back") procedures. However, in other situations in which confirmations are less meaningful, procedures such as sales transactions verification and subsequent collections observation may be viewed as primary procedures. Thus, these sets of audit procedures (confirmations versus verification and observation), depending upon specific audit circumstances, may be viewed as at least partially substitutable for each other. Further,

given that either procedure has been performed and satisfactory evidence obtained, there is little incremental benefit of performing the other procedure. Thus, for example, if sales transactions and subsequent collections have been verified, confirmations would provide only very limited additional evidence about the existence of recorded accounts. However, when neither procedure has been performed, the incremental benefit of satisfactorily performing a single procedure (either) would be large.

Misstatement risk judgments reflecting these domain-specific features will appear as negative ordinal interactions within an ANOVA framework. Representing the relations graphically, significant ordinal interactions are those in which the slopes of lines connecting the risk judgments at the various levels of the constituent information cues are significantly different from each other, but have the same algebraic signs. A negative ordinal interaction is one in which these lines are "right-opening" and a positive ordinal interaction is one in which these lines are "left-opening." Thus, for a negative ordinal interaction there is a greater effect (i.e., change in judgment) when the primary audit procedure has not been performed, than when the primary procedure has been performed. In other words, a negative ordinal interaction is one in which the largest effect is due to the substitutable procedure's compensation for the absence of the primary procedure.<sup>9</sup>

Based on this framework of domain-specific auditing knowledge, the following alternative-form hypotheses were developed:

### Criterion 1: Explained Variance Attributable by ANOVA:

- H1: The frequency of configural information processing defined by significant interactions:

The percent of auditors having significant misstatement risk assessment variance attributable to interactions of relevant audit procedures will be significantly greater than zero.

- H2: Given configural information processing, the relative proportions represented by hypothesized and non-hypothesized interactions:

For auditors having significant misstatement risk assessment variance attributable to interactions of relevant audit procedures, the proportion with a significant interaction of substitutable audit procedures will be larger than that of any other significant interaction.

- H3: The general form of configural information processing as defined by an hypothesized interaction:

The form of the interaction between substitutable audit procedures will be negative ordinal.

- H4: The specific attributes of configural information processing as defined by an hypothesized interaction:

- a. When neither substitutable audit procedure has been performed, assessments of misstatement risk will be significantly larger than when a single substitutable procedure has been performed.
- b. When both substitutable audit procedures have been performed, assessments of misstatement risk will not be significantly smaller than when only a single substitutable procedure has been performed.

### Criterion 2: ANOVA Judgment Model Prediction Error:

- H5: Judgment models containing all significant terms will produce prediction errors that are significantly smaller than those of models which exclude significant interactions of substitutable audit procedures.

## Experiment

### Subjects

Subjects were 95 audit seniors with 3 to 4 years of audit experience. The subjects were employed by the same national CPA firm, and participated either at their office (12 subjects) or while attending a technical training school (83 subjects).

### Accounts Receivable Audit Procedures Case

Based on the earlier auditing framework, a hypothetical audit procedure evaluation case was developed in which configural information processing would be consistent with fundamental domain-specific auditing knowledge. The specific auditing context was appraisal of the evidence provided by a portion of an audit program for a company's accounts receivable. The case included background information and specific information concerning controls or procedures (presented in Appendix A), and specimen stimuli presentations.

The subjects were told that they would be presented with a series of the accounts receivable audit program checklists (completed by an auditor on their staff) and asked to assess, given the audit evidence-to-date, audit risk related to a particular assertion (indicated below). An example of the accounts receivable audit program checklist is presented in Exhibit 1. Procedures one and two were intended to be substitutable accounts receivable audit procedures and thus, are the constituent variables of the interaction expected in hypotheses two and three. Five of the six audit procedures (numbers 1, 2, 3, 5 and 6 in

Exhibit 1) were factorially manipulated at two levels each (completed with no exceptions noted or not completed as of this date), and one procedure (4 in Exhibit 1) was held constant (completed with no exceptions noted).

#### INSERT EXHIBIT 1 ABOUT HERE

For each audit program checklist, the subjects were asked to assess the following misstatement risk (elicited on a 100-point scale where 0 was no risk and 100 was maximum risk):

Given the audit evidence as represented by the partially completed audit program segment (above), assess the risk that the year-end accounts receivable balance could be materially misstated AS A RESULT OF recorded accounts NOT EXISTING.

#### Research Design

The research design was a one-half fractional replication of the factorial manipulation of five information cues involving audit procedures, each cue at two levels.<sup>10</sup> An ANOVA was computed for each subject's risk assessments. Although each ANOVA estimated all main effects (5) and two-way interactions (10), the higher-order (three, four and five-way) interactions are aliases of the estimated effects and thus, are assumed to be negligible.<sup>11</sup> In addition, since such ANOVAs are determined fully (i.e., the percent of explained risk assessment variance for the estimated effects will equal 100 percent), there is no error estimate (i.e., error sum of squares will equal zero). Results of a pilot study employing a full  $2^5$  ANOVA design, however, indicated that effects  $\geq 2\%$  explained risk assessment variance were significant.<sup>12</sup> Consequently, for the present one-half



replication design a level of  $\geq 4\%$  explained risk assessment variance was used as the significance criterion (i.e., terms with less than 4% explained variance were assumed to have been caused by random variation rather than systematic effects).

#### Dependent Variables: Judgment Evaluation Criteria

Two criteria were used to evaluate subjects' ANOVA judgment models: percent of explained judgment variance and judgment model prediction differences. The percent of explained judgment variance for each term within a subject's ANOVA model was computed by dividing the sum of squares for the term by the total sum of squares for the model. Judgment model prediction differences were computed by first constructing two judgment models for each subject: a full model containing all above-criterion (i.e.,  $\geq 4\%$  explained variance) terms and a reduced model. The reduced model was the same as the full model, except that the former excluded the hypothesized interaction. For each subject, both models were then used to predict the half-replication cue combinations that were not used to fit the models. Judgment model prediction difference was computed as the audit risk predicted by the reduced model minus that predicted by the full model.

#### Procedures

The experiment laboratory session consisted of two sections, training and experiment. Both sections were presented on personal computers. Subjects completed the sections at their own

pace (the average time was 36.4 minutes per training section and 22.4 minutes per experiment section).<sup>13</sup>

The training section began with brief instructions on the personal computer, and was followed by an audit procedures evaluation case involving inventories. Each subject evaluated four manipulations of the practice inventories case to gain familiarity using the response scale and two decisions aids available in the experiment section.<sup>14</sup>

The experiment section began with presentation of background information concerning the case, and was followed by a blank copy of the case's audit program checklist, additional instructions<sup>15</sup> and additional specific information.<sup>16</sup> The subjects then responded to a series of questions designed to stimulate prior thought about relations between the items listed on the checklist and the specific audit objectives for which they were being asked to make risk assessments.<sup>17</sup>

Following these series of questions, the subjects were presented sequentially with the 16 checklists from one of the half-replications (randomized over subjects). The order of the checklists (i.e., the cue combinations) within each half-replication was randomized for each subject. In addition, the order of the items on the checklist was counter-balanced; one-half of the subjects received one order and the other one-half received a second order. Finally, the subjects responded to a post-experimental questionnaire.

## Results

Configural Cue Usage as Interactions. As indicated in Table 1, 79 of the 95 subjects (83.2%) responding to the audit procedures case exhibited at least one interaction with explained risk assessment variance in excess of the 4% significance criterion. This proportion is significantly greater than zero ( $p < .01$ ) and thus, hypothesis one is supported.

INSERT TABLE 1 ABOUT HERE

The magnitude of explained risk assessment variance attributable to above-criterion interactions averaged 15.76% over the 79 subjects, which is significantly greater than zero ( $t[78] = 14.7$ ,  $p < .01$ ). Similar to prior research results, the explained judgment variance attributable to above-criterion main effects averaged 78.04% over all 95 subjects (75.76% over the 79 subjects) and thus, total above-criterion explained variance averaged 93.79% over all subjects (91.52% over the 79 subjects).

Configural Cue Usage as Specific Interactions. As indicated in Table 1, 46 of the 79 subjects (58.2%) exhibited above-criterion explained variance for the hypothesized interaction of confirmation by verification/observation procedures (AB in Table 1). In comparison, the next most frequent above-criterion interaction only was exhibited by 24 of the 79 subjects (30.4%), which is significantly smaller than the frequency of the hypothesized interaction ( $X[1]^2 = 9.975$ ;  $p < .01$ ). These results support hypothesis 2.

The magnitude of risk assessment variance explained by the above-criterion hypothesized interaction averaged 12.66% over the 46 subjects. This mean not only is significantly greater than zero ( $t[45] = 13.54$ ;  $p < .01$ ), but also is significantly greater than that of the next largest (non-hypothesized) interaction ( $t[68] = 2.61$ ;  $p < .01$ ). Further, over the 79 subjects, the hypothesized interaction accounted for 46.8% of the explained risk assessment variance attributable to all ten interactions.

Form of Specific Interactions. Based on graphical inspections, the above-criterion hypothesized interactions for forty-five of the 46 subjects (97.8%) were negative ordinal in form. This result supports hypothesis 3.

The mean risk assessments for each level of the hypothesized interaction are presented in Table 2. A one-way repeated measures ANOVA indicated that these cell means significantly differ ( $F[3,537] = 236.4$ ;  $p < .01$ ). Tukey's test over the levels of this interaction indicated that the mean risk assessment was significantly higher when neither substitutable audit procedure had been performed (NN in Table 2) than when any (or both) audit procedures were performed (NY, YN and YY in Table 2).<sup>18</sup> In addition, when both substitutable procedures had been performed (YY in Table 2), the mean risk assessments were not significantly smaller than when either substitutable procedure had been performed singly (NY and YN in Table 2). Together, these results support hypotheses 4a and 4b.

INSERT TABLE 2 ABOUT HERE

Judgment Model Prediction Differences. Full and reduced judgment models were formed for the 45 subjects whose hypothesized interaction (AB in Table 1) was above-criterion and well-formed. The risk assessments predicted by these judgment models for the levels of the hypothesized interaction are presented in Table 3. Over the 45 subjects, the mean absolute difference between the full and reduced model predictions within each level of the hypothesized interaction was 8.81. These prediction differences are significantly greater than zero ( $t[44] = 2.945$ ;  $p < .01$ ), thus supporting hypothesis 5.

INSERT TABLE 3 ABOUT HERE

Further, over the 45 subjects the absolute risk assessment differences between the judgment models ranged from 20.0 to 1.6, and the mean for the upper quintile ( $n=9$ ) of differences is 15.7 (see Table 3). This difference appears especially critical for the hypothesized interaction level in which both audit procedures have been performed. In this level, the full model predicts audit risk to be 18.21%, whereas the reduced model, underestimating 15.7%, predicts audit risk to be 2.5%.

Explained Variance Related to Predictive Ability. Earlier, an argument was made that knowledge of a factor's (i.e., cue or cue pattern) explained variance does not necessarily imply knowledge of that factor's predictive ability. For the 45 subjects whose hypothesized interaction was above-criterion and well-formed, the correlation between the explained variance criterion (i.e., the proportion of judgment variance attributable to the

hypothesized interaction) and the predictive ability criterion (i.e., the absolute magnitude of their judgment model prediction difference caused by dropping the hypothesized interaction from the model) was 0.688. That is, only 47.3% of the variance in one criterion can be predicted from the knowledge of the other criterion. An extreme example of the lack of perfect correlation is a subject who had only 6.38% explained variance attributable to the hypothesized interaction (39th out of 45 in size), was ranked 9th out of 45 in size given his (her) judgment model risk assessment prediction difference of 11.5%. Similarly, another extreme example is a subject who had 18.06% explained variance attributable to the hypothesized interaction (10th out of 45 in size), had a judgment model risk assessment prediction difference of only 1.62% (45th out of 45 in size).

## Discussion

Using the explained variance criterion, the evidence suggests that a high proportion of the auditor-subjects processed information configurally and, in addition, the nature of the configural processing was predictable based on domain-specific knowledge. Not only is the average explained variance for the single hypothesized interaction over three times that of any single interaction in prior auditing studies (e.g., 12.66% versus just under 4% in the Ashton [1974] study), it is larger than the cumulative explained variance of all interactions in most such studies (e.g., just over 6% in the Ashton [1974] study). Similarly, the mean explained variance attributable to this study's

single hypothesized interaction is greater than the sum of the explained variance of all of the interactions in most prior psychological study (e.g., approximately 10% in the Hoffman, Slovic and Rorer [1968] study, which is one of the highest).

The prediction criterion provided additional evidence about the import of configularity, clearly indicating that substantial errors could be made if configural terms were to be removed from judgment model. Again examining the first quintile of judgment model risk predictions (see Table 3), when both substitutable audit procedures have been preformed the reduced model failed to reflect the notion that the marginal value of a second substitutable audit procedure is substantially less than the value of the first procedure (such a notion is contained in the interaction term). Thus, the reduced model, for this quintile, seriously underestimates the risk that accounts receivable are misstated and, as a result, jeopardizes the effectiveness of an audit program prepared based on such an assessment.

### Concluding Remarks

In this paper we have argued that configural information processing is a skill that many experienced auditors have developed. This thesis, which is in conflict with prior auditing research, was investigated in an experiment in which practicing auditors responded to a case involving the basic audit task of audit evidence evaluation. It was suggested that two characteristics of the prior audit research are responsible for the prior research reports that auditors' information processing is not

configural. First, following Frederick and Libby [1986], we observed that domain-specific knowledge, while not brought to bear in prior research, is crucial for developing expectations for, and thus, demonstrating configural processing. Second, following Schepanski [1983], we argued that prior auditing studies used both a limited detector of configurality and focused on an insufficient criterion (explained variance) for its import. These arguments, in concert, provided the motivation for our experimental investigation of auditor configural information processing.

The results of the experiment were consistent with expectations and thus, support our central thesis. That is, when the researcher uses his/her understanding of the audit domain to determine which judgment tasks might be more effectively (efficiently) accomplished using configural processing, develops an understanding of what configural processing would be for such tasks, constructs sufficiently realistic experimental tasks to stimulate such configural processing, auditors expert in that domain will exhibit configural processing.

This study suggests that the conventional judgment study characterization of auditors' cognition should be reconsidered. Such reconsideration is important from both research and practice perspectives. From the former perspective, answers to the fundamental questions of how and how well auditors process information may be quite different depending upon available evidence concerning the ability to process information configurally and thereby,



incorporate concepts such as diminishing marginal returns into their judgment policies. From the latter perspective, recent technological advances have enhanced the practical feasibility of expert systems and other computer-based judgment models. Such models should be based, however, upon the more sophisticated characterization of audit judgment formulation reflected in this study rather than that in earlier studies.

APPENDIX A  
ACCOUNTS RECEIVABLE AUDIT PROCEDURES CASE

Assume you are a senior-level auditor and that one of your clients is Agco, Inc. Agco, a large processor of corn and soy-bean products, is a privately held company with publically traded bonds that require audited financial statements prepared in accordance with GAAP. The company has not presented significant auditing problems during your firms's five-year tenure as its public auditor, and has maintained moderately good internal accounting control systems. During the past two years, Agco has been computerizing its accounting and information systems.

Currently, you are performing Agco's 1988 year-end audit and are evaluating evidence provided by the audit of accounts receivable. During engagement planning, the inherent risk that a material error could arise in accounts receivable was assessed to be moderate for both existence and valuation. For 32 randomly ordered cases, you will be presented with the results from a portion of the accounts receivable audit program performed by your staff auditors. For each case, you will be asked to assess the risk that accounts receivable, given the audit evidence-to-date, could be materially misstated AS A RESULT OF recorded accounts NOT EXISTING at year-end.

Additional accounts receivable audit procedures information:

- A. The sample for accounts receivable confirmation was drawn to obtain 95% reliability estimates. WHEN indicated as being COMPLETED, responses have been received (through second and third requests) from 100% of the sample.
- B. Verification of accounts receivable sales transactions and observation of subsequent collections is a SEPARATE audit procedure from the confirmation of those accounts. The sample for this procedure (also drawn to obtain 95% reliability estimates) is INDEPENDENT of that for the confirmations.
- C. The analytical procedures used to verify the adequacy of the allowance for bad debts are to compare the current year's number of days accounts outstanding with that of previous years, and to compare the allowance as a percentage of accounts receivable with that of previous years.
- D. The aged accounts receivable listing is reviewed for material receivables from affiliates, directors, and other related parties; notes and long-term receivables; and accounts with significant credit balances.

## FOOTNOTES

1. See Hammond and Summers [1965], Goldberg [1968], Slovic and Lichtenstein [1971] and Slovic, Fishhoff and Lichtenstein [1977] for reviews of the psychology studies and Ashton [1982, 1983] and Libby [1981] for reviews of the auditing studies.
2. See, for example, Ashton and Kramer [1980], Ashton and Brown [1980], Hamilton and Wright [1982], Reckers and Taylor [1979], Hall, Yetton and Zimmer [1982] and Trotman, Yetton and Zimmer [1983].
3. See Slovic [1969], Rorer, Hoffman, Dickman and Slovic [1967] and Leon, Oden and Anderson [1973] for examples of studies that report some evidence for configural processing.
4. See, for example, Hammond and Stewart [1974], Libby [1981], Schepanski [1983] and Trotman and Yetton [1985].
5. That is, each information cue, independent of other cues, is monotonically related to the judgments of individuals who utilize them.
6. The constituent variable with the larger explained variance is the primary variable, and the constituent variable with the smaller explained variance is the mediating variable.
7. Prediction error, in this study, is defined to be the difference between predictions by a general linear model of an individual's judgments made both with and without the term in question. Since overall mean absolute prediction error could mask offsetting error types, such errors should be examined within the levels of the term in question.
8. Interestingly, if one looks outside of the auditing literature to an accounting study, one sees some evidence supporting these arguments. Schepanski [1983], studying information processing for the task of evaluating credit worthiness, in addition to employing standard ANOVA, employed qualitative analysis of predictive ability to appraise whether nonlinearity (configurality) was present in his subjects' credit worthiness judgments. Consistent with his expectations, the two evaluation criteria supported different conclusions. In particular, the ANOVA explained variance results were consistent with the literature in psychology and auditing indicating clear support for the linear model (i.e., significant configurality was not evident). Schepanski's qualitative analysis, however, revealed that prediction errors would increase substantially if configural terms were to be removed from the credit worthiness judgment models.

9. In contrast, a positive ordinal interaction is one in which the largest effect is the other audit procedure's amplification of the effect of the primary procedure's presence.
10. Using Winer (1971), the defining relation was (ABCDE).
11. Pilot study results in which full (non-fractional) ANOVA's were estimated indicated no significant three, four or five-way interactions (n=16).
12. The higher-order (three, four and five-way) interactions were used as estimates of error.
13. Forty-six of the 95 subjects previously had completed an experiment not relevant to the current paper. A total of 123 auditor-subjects were randomly assigned (using a 40/60 assignment ratio) to either the experiment reported in this paper (49 subjects) or another experiment (74 subjects). The other experiment first determined whether its assigned subjects were configural information processors for its task (internal control structure evaluation), which was different from that of the current study (audit procedures evaluation). The configural subjects (28) continued with the internal control structure evaluation experiment, and the non-configural subjects (46) switched experiments and next completed the auditing task employed in this paper (which, together with the 49 subjects assigned directly, produces the sample of 95 subjects reported in the current study). This subject assignment procedure could produce a conservative bias (with respect to the hypotheses) in the results reported in the current paper. Specifically, subjects who were configural on the other experiment's audit judgment task were not available for inclusion in the current paper's subject sample. To the extent that learning to be a configural information processor generalizes to other (related) tasks, the proportion of auditors who are configural on the current paper's audit judgment task could be understated.
14. The two decision aids were an electronic file and a logical consistency checker. When assessing risk, the subject had access to an electronic file of checklists that he (she) had already evaluated. Previous evaluations could not be changed. As the subject worked through the checklists, the computer reviewed the assessments for logical consistency (i.e., dominance conditions). If the computer detected an apparent logical inconsistency, that fact was displayed and the subject had the option of either changing or maintaining his (her) assessment of the current checklist.
15. The subjects were instructed to ignore the temporal sequence of the checklists, and that these checklists would provide a mixture of possible situations. Further, the subjects were told that although in actual practice some situations may

occur less frequently than others, they should not allow such frequency to affect their risk assessments.

16. The additional information concerned the auditor's accounts receivable audit program, and is presented in Appendix A.
17. For each listed cue (audit procedure), the subject was asked to think about things that could go wrong or misstatements that could go undetected if the procedure was not performed. The subject was asked to indicate the most serious thing or misstatement, and to indicate the procedure's importance for achieving the specified audit objective.
18. The critical Tukey value at  $p=.01$  was 6.84.

## REFERENCES

- American Institute of Certified Public Accountants, "Audit Risk and Materiality in Conducting an Audit," Statement on Auditing Standards No. 47 (AICPA, 1983).
- Ashton, R. H., "An Experimental Study of Internal Control Judgments," Journal of Accounting Research (Spring 1974), pp. 143-157.
- Ashton, R. H., Human Information Processing in Accounting (Sarasota, FL: American Accounting Association, 1982).
- Ashton, R. H., Research in Audit Decision Making: Rationale, Evidence, And Implications (Vancouver, British Columbia: Canadian Certified General Accountant's Research Foundation, 1983).
- Ashton, R. H. and P. R. Brown, "Descriptive Modeling of Auditors' Internal Control Judgments: Replication and Extension," Journal of Accounting Research (Spring 1980), pp. 269-277.
- Ashton, R. H. and S. S. Kramer, "Students as Surrogates in Behavioral Accounting Research: Some Evidence," Journal of Accounting Research (Spring 1980), pp. 1-15.
- Brown, C., and Solomon, I., "Configural Processing in Audit Internal Control Evaluation," Unpublished working paper, University of Illinois, 1989.
- Frederick, D. M. and R. Libby, "Expertise and Auditors' Judgments of Conjunctive Events," Journal of Accounting Research (Autumn 1986), pp. 270-290.
- Goldberg, L. R., "Simple Models or Simple Processes? Some Research on Clinical Judgments," American Psychologist (July 1968), pp. 483-496.
- Hall, C., P. Yetton and I. Zimmer, "The Assessment of Payroll Internal Control Systems and Auditors' Experience, Tolerance of Ambiguity, and Dogmatism," Australian Journal of Management (June 1982), pp. 49-60.
- Hamilton, R. E. and W. F. Wright, "Internal Control Judgments and Effects of Experience: Replications and Extensions," Journal of Accounting Research (Autumn 1982, Part II), pp. 756-765.
- Hammond, K. R. and D. A. Summers, "Cognitive Dependence on Linear and Nonlinear Cues," Psychological Review (May 1965), pp. 215-234.

- Hammond, K. R. and T.R. Stewart. "The Interaction Between Design and Discovery in the Study of Human Judgment," Program of Research on Human Judgment and Social Interaction, Institute of Behavioral Science, Unpublished Manuscript No. 152, The University of Colorado, 1974.
- Hoffman, P. J., "Cue-Consistency and Configurality in Human Judgment," in B. Kleinmuntz, ed., Formal Representation of Human Judgment (Wiley, 1968).
- Hoffman, P. J., P. Slovic and L. G. Rorer, "An Analysis-of-Variance Model for the Assessment of Configural Cue Utilization in Clinical Judgment," Psychological Bulletin (May 1968), pp. 338-349.
- Leon, M., G. C. Oden, and N. H. Anderson, "Functional Measurement of Social Values," Journal of Personality and Social Psychology (1973), pp. 301-310.
- Libby, R., Accounting and Human Information Processing (Englewood Cliffs, NJ: Prentice-Hall, 1981).
- Mock, T. and A. Wright, "Evaluating the Effectiveness of Audit Procedures," Auditing: A Journal of Practice and Theory (Fall 1982), pp. 33-43.
- Reckers, P. M. J. and M. E. Taylor, Consistency in Auditors' Evaluations of Internal Accounting Controls," Journal of Accounting, Auditing and Finance (Fall 1979), pp. 42-55.
- Rorer, L., P. J. Hoffman, H. R. Dickman, and P. Slovic, "Configural Judgments Revealed," Proceedings of the 75th Annual American Psychological Association Convention (1967), pp. 195-196.
- Schepanski, A., "Test of Theories of Information Processing Behavior in Credit Judgment," The Accounting Review (July 1983), pp. 581-599.
- Slovic, P., D. Fleissner and W. S. Bauman, "Analyzing the Use of Information in Investment Decision Making: A Methodological Proposal," Journal of Business (April 1972), pp. 283-301.
- Slovic, P., B. Fischhoff and S. Lichtenstein, "Behavioral Decision Theory," Annual Review of Psychology (1977), pp. 1-39.
- Slovic, P. "Analyzing the Expert Judge: A Descriptive Study of a Stockbroker's Decision Processes," Journal of Applied Psychology (August 1969), 255-263.

- Slovic, P. and S. Lichtenstein, "Comparison of Bayesian and Regression Approaches to the Study of Information Processing in Judgment," Organizational Behavior and Human Performance (November 1971), pp. 649-744.
- Trotman, K. T., and P. W. Yetton, "The Effect of the Review Process on Auditor Judgments," Journal of Accounting Research (Spring 1985), pp. 256-267.
- Winer, J. L., "Fundamentals of Experimental Design," 2nd Ed. (Boston, MA: Allyn and Bacon, 1972).
- Wright, A. and Mock, T., "Toward a Contingency View of Audit Evidence," Auditing: A Journal of Practice and Theory (Fall 1985), pp. 91-100
- Yntema, D.B., and W.S. Torgerson, "Man-Computer Cooperation in Decisions Requiring Common Sense," IEE Transactions on Human Factors in Electronics (1961), pp. 20-26.



EXHIBIT 1

Accounts Receivable Audit Procedures Checklist

PROCEDURE	RESULTS
1. Confirm a 95% reliability sample of year-end A/R (positive form).	
2. Verify sales transactions for and observe collections of a 95% reliability sample of year-end A/R.	
3. Reconcile A/R subsidiary ledger to the general ledger control account.	
4. Verify adequacy of allowance for bad debts using analytical procedures.	
5. Review aged A/R listing for related party transactions, long-term notes, etc.	
6. Review Board of Directors' meeting minutes and correspondence files to determine if receivables were factored or discounted.	

TABLE 1

Distribution Statistics for Above-Criterion Proportion of  
Explained Judgment Variance

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<u>Source</u>	<u>Mean</u>	<u>Std.Dev.</u>	<u>Freq.</u>
A	43.67	22.62	95
B	18.85	10.73	76
C	22.89	19.16	65
D	8.96	4.70	22
E	7.05	2.88	21
Total Main Effects	78.04	10.78	95
AB	12.66	6.34	46
AC	8.82	4.72	24
AD	8.24	2.79	10
AE	4.96	1.15	9
BC	7.17	3.28	14
BD	4.42	0.25	2
BE	6.02	2.66	8
CD	6.23	2.56	8
CE	5.68	0.99	7
DE	6.37	2.61	12
Total Interactions	15.76	9.52	79

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NOTE: Sources, keyed to audit procedure numbers in Exhibit 1,  
are: A = procedure 1; B = 2; C = 3; D = 5; and E = 6.

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TABLE 2  
Risk Assessments Within the Hypothesized Interaction

	<u>Levels of the Hypothesized Interaction</u>			
	<u>YY</u>	<u>YN</u>	<u>NY</u>	<u>NN</u>
Mean	23.19	28.50	33.89	74.45
Std. Dev.	22.65	21.81	22.34	23.33
N	180	180	180	180

NOTES: The hypothesized interaction is AB in Table 1. The levels are: YY = both audit procedure A and B have been completed and no exceptions noted; YN = A has been completed, but B has not; NY = B has been completed, but A has not; and NN neither A nor B has been completed.

TABLE 3

## Judgment Model Predictions of Risk Assessments

Overall (n=45)

<u>Judgment Model</u>	<u>Levels of the Hypothesized Interaction</u>			
	<u>YY</u>	<u>YN</u>	<u>NY</u>	<u>NN</u>
Full	23.24	28.44	33.95	74.39
Reduced	14.43	37.25	42.76	65.58
Difference	-8.81	8.81	8.81	-8.81

Judgment Model Difference Quintiles (n=9)

<u>Quin- tile</u>	<u>Judgment Model</u>	<u>Levels of the Hypothesized Interaction</u>			
		<u>YY</u>	<u>YN</u>	<u>NY</u>	<u>NN</u>
1	Full	18.21	23.24	27.57	95.42
	Reduced	2.50	38.94	43.27	79.71
	Difference	-15.70	15.70	15.70	-15.70
2	Full	32.28	37.17	42.47	89.14
	Reduced	21.83	47.61	52.92	78.69
	Difference	-10.44	10.44	10.44	-10.44
3	Full	22.36	30.75	35.69	77.64
	Reduced	13.97	39.14	44.08	69.25
	Difference	-8.39	8.39	8.39	-8.39
4	Full	23.78	28.81	32.72	61.92
	Reduced	17.74	34.85	38.76	55.88
	Difference	-6.04	6.04	6.04	-6.04
5	Full	19.60	22.25	31.29	47.84
	Reduced	16.13	25.72	34.77	44.36
	Difference	-3.47	3.47	3.47	-3.47

NOTES: The hypothesized interaction is AB in Table 1, and its levels are the same as in Table 2. The prediction differences are determined by subtracting the full model's risk assessment predictions from those of the reduced model: thus, a negative sign implies that the reduced model is underestimating risk relative to the full model.

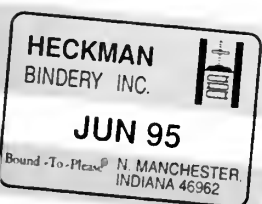












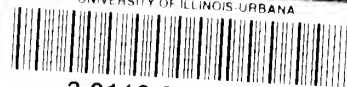
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